Native Plant Material Development: A Genetic Perspective

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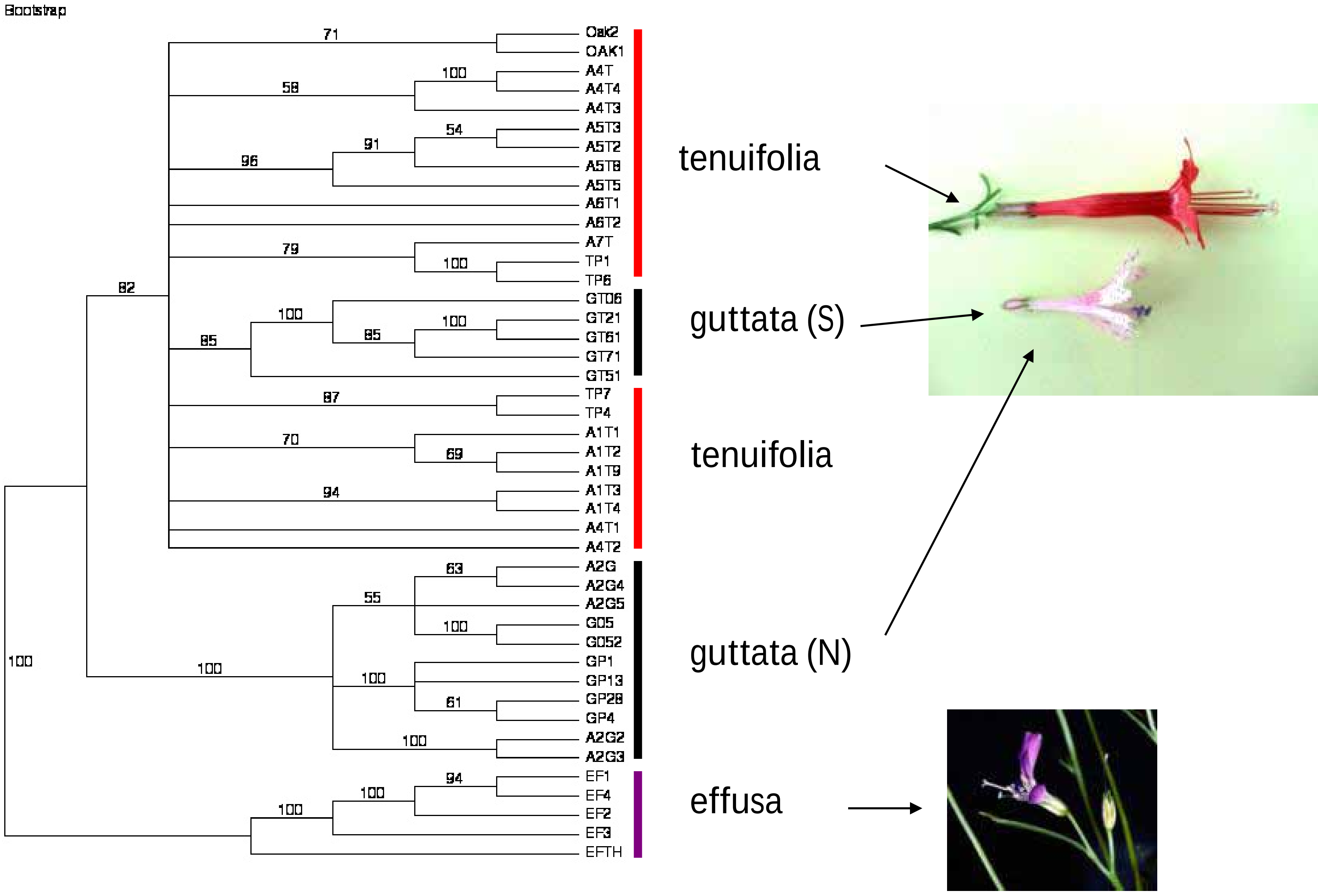
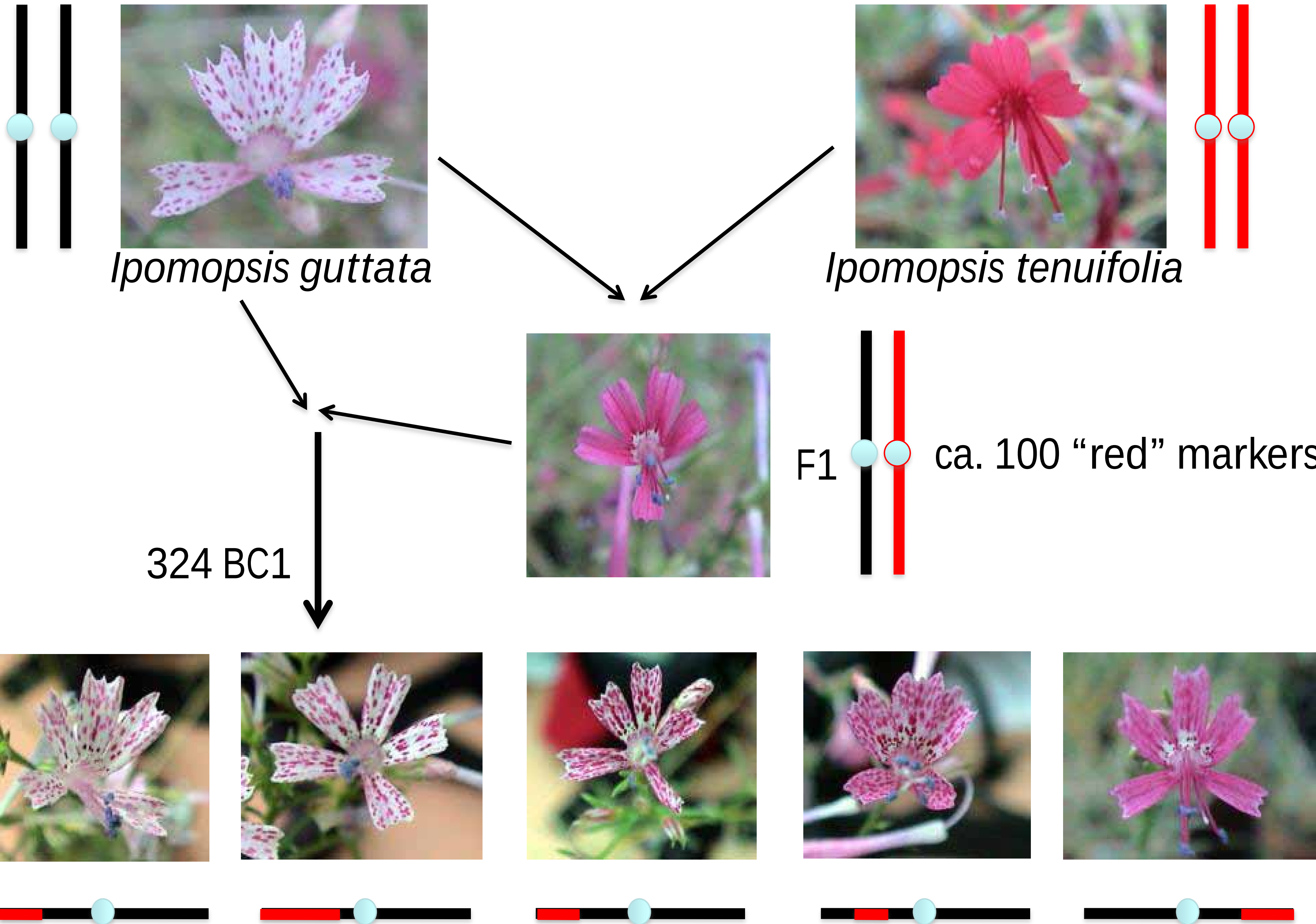
Morphological vs. Genealogical Groups: AFLP phenogram of *Ipomopsis* spp.

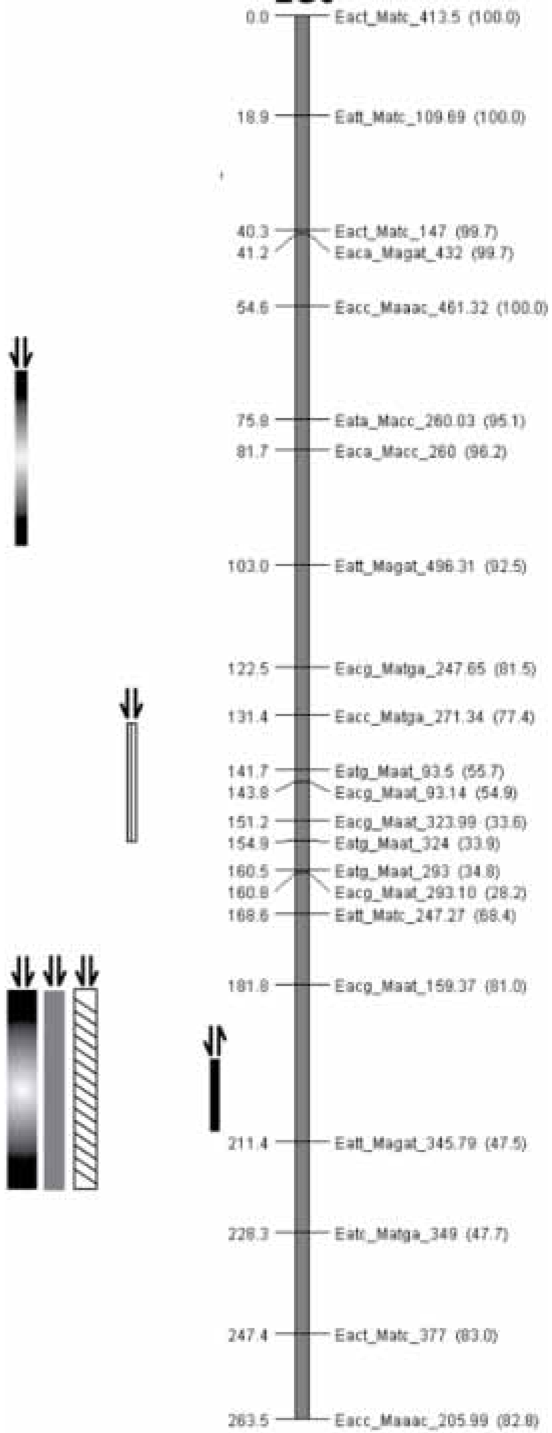


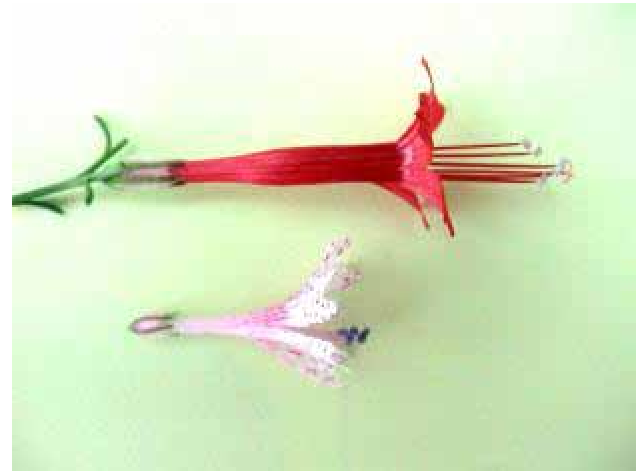
Mine and Many, Many other Studies:

<u>Abundant Genetic Variation but Only Small Portion is Ecologically Relevant (Adaptive)</u>



Ipomopsis guttata
Ipomopsis tenuifolia
F1
ca. 100 “red” markers
324 BC1





Stamen Length = 13.9%

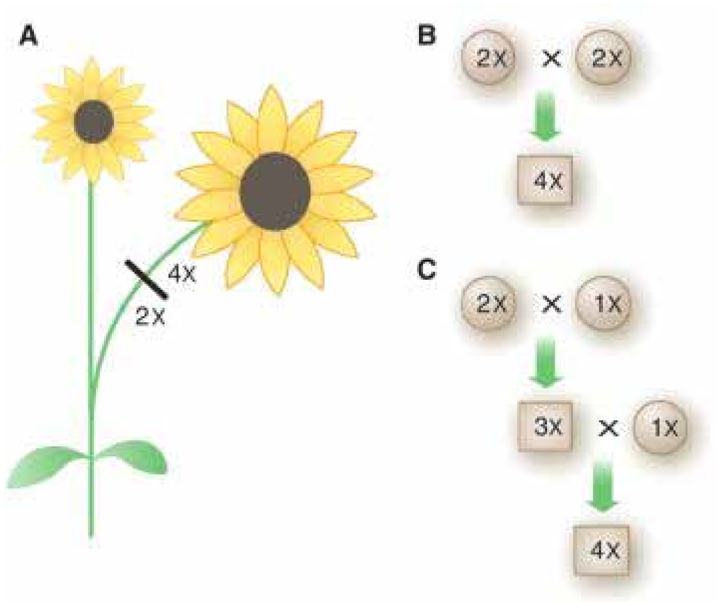
Pistil Length = 11.0%

Tube Length = 15.1%

Mine and Many, Many other Studies:

<u>Genes Under Selection Often Have a Large Effect on Phenotype</u>

Polyploidy and plant diversity



Rieseberg and Willis 2007

Polyploidy = heritable increase in genome copy number

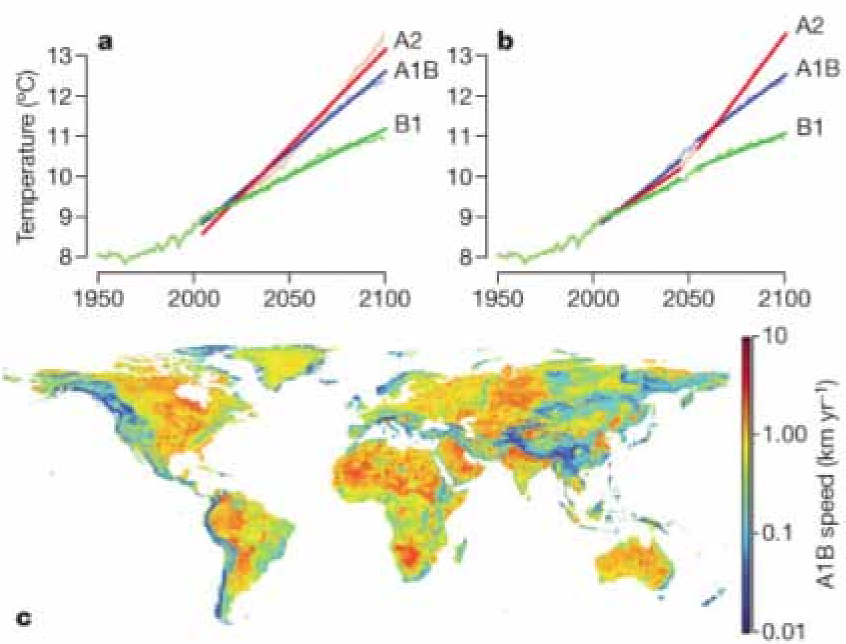
-- polyploidy à 15% of new plant species

-- **nearly 20% of species harbor polyploid races**

Climate Change and Response of Plant Populations

- Species have 3 potential “choices”:
  - Move (Parmesan 2003)
  - Respond plastically
  - Evolve, i.e. respond genetically

But Can Plants Move Fast Enough?



Loarie et al. 2009

<u>“velocity” required to maintain constant temperatures:</u>

0.42 km/yr

(global mean)

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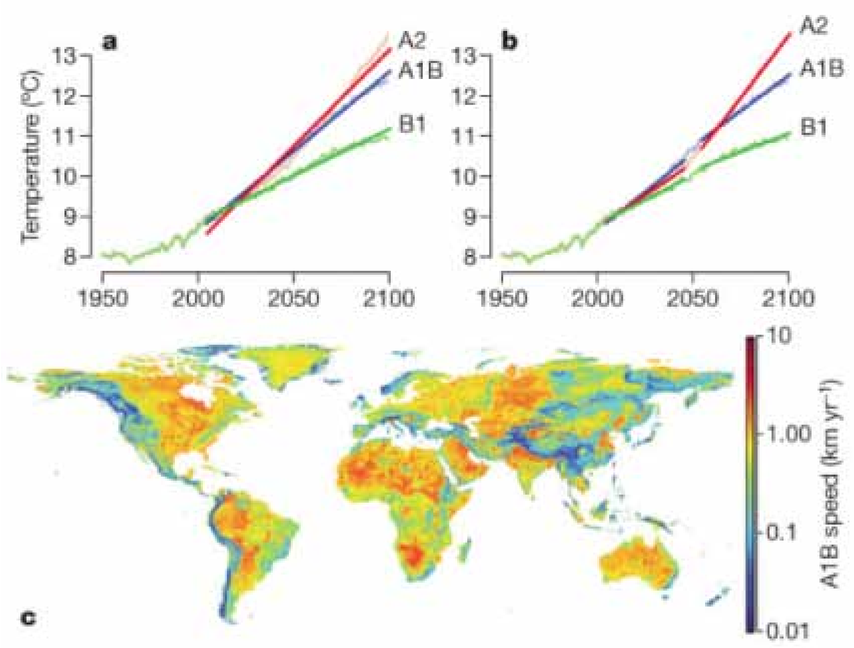
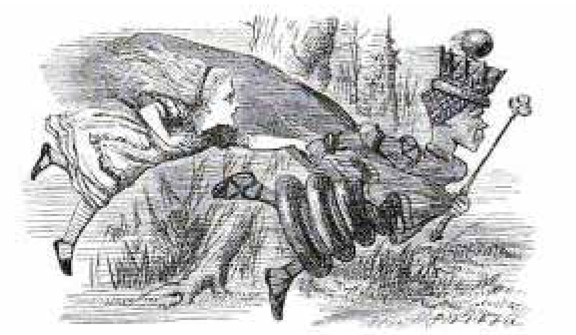


Loarie et al. 2009

local velocity required to maintain constant temperatures:

0.42 km/yr

(global mean)



"It takes all the running you can do, to keep in the same place."

--The Red Queen

Climate Change and Response of Plant Populations

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Natives: Selection and Increase

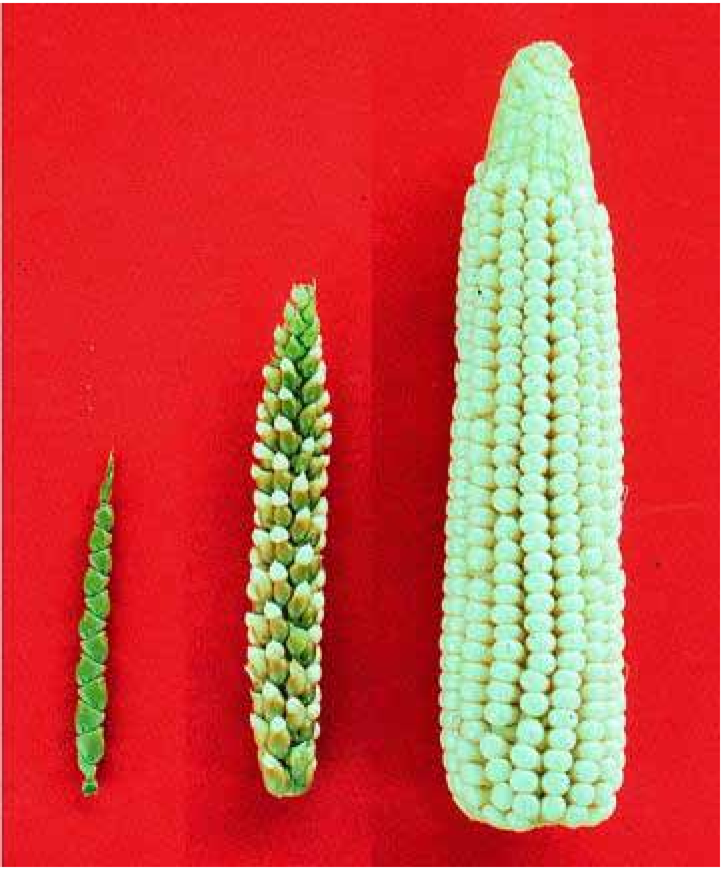
- Many advantages to using natives v. nons:
  - Aesthetic
  - Evolved *in situ* à Adapted/Adaptable à Establishment Success
  - Use fundamental to restoration of ecosystem resilience

- Concerns
  - Limited initial sampling: ↓ genetic diversity; outbreeding depression
  - Artificial sel'n during increase: ↓genetic diversity

Fine Scale Adaptation in Scarlet Gilia

Nick Waser and Mary Price (89) reported a strong effect of crossing distance on offspring fitness—fitness reduced by almost half at 90m (!) relative to optimum

Artificial Selection



–Artificial Selection is powerful/rapid

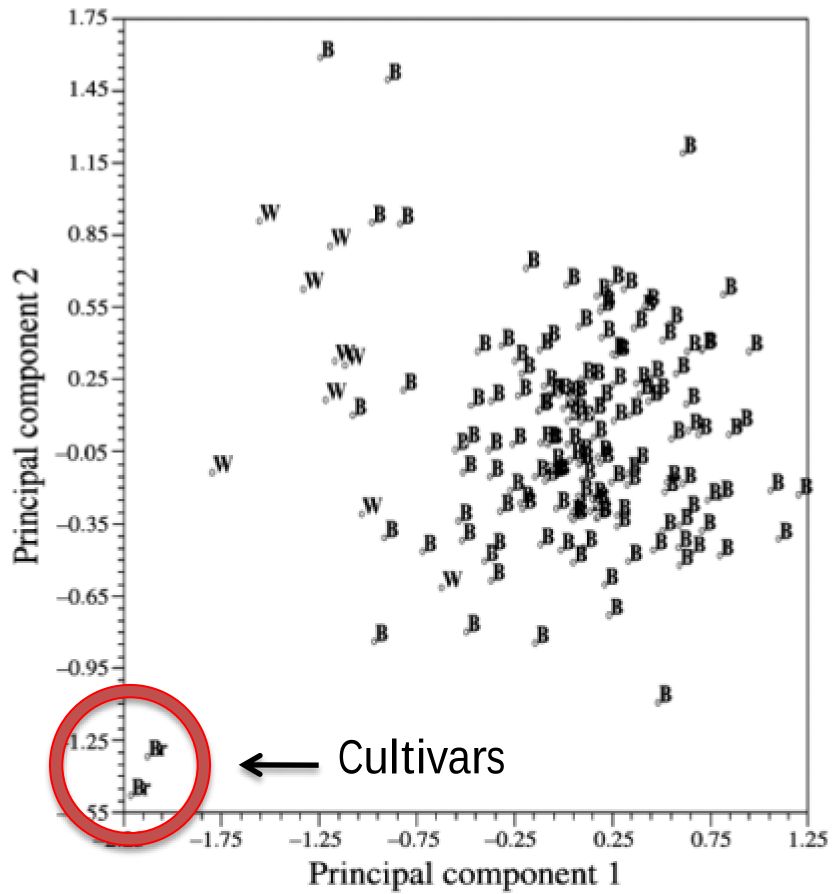
–alleles favored agronomically expected to have deleterious effects in nature

–AS reduces heritable variation

–pollen limitation (forbs) exacerbates this effect

Thus AS can lead to maladaptive traits and is expected to limit evolvability

Artificial Selection



Indian Ricegrass

(courtesy Mark Miller)

–Selfing (strong genetic differentiation)

–Early Seral

–Broad Ecological Amplitude, e.g., 2–10,000 ft. elev.

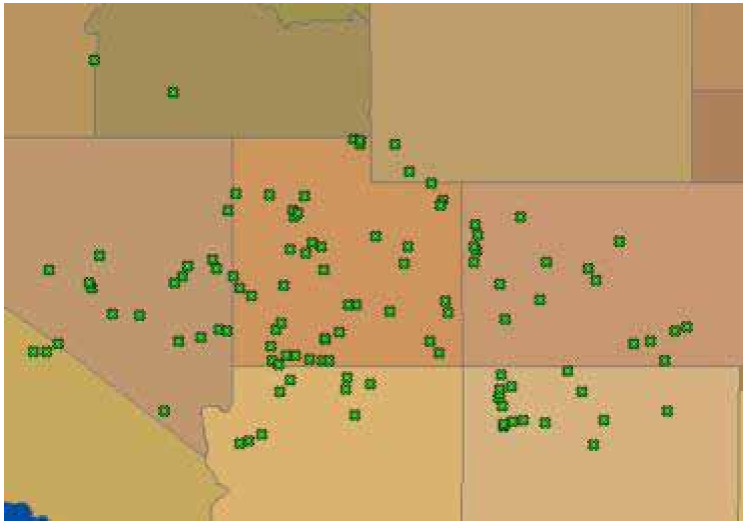
–Drought Tolerant

–Cultivars available but lack information on scale of local adaptation across natural pops

--Cool season

Ecological Genetic Analysis of Indian Ricegrass

with RC Johnson and Ted Kisha, USDA ARS, Pullman



Accessions currently under evaluation

Two Common Gardens:

–Time to first flower

–Leaf length

–# panicles
–dry weight

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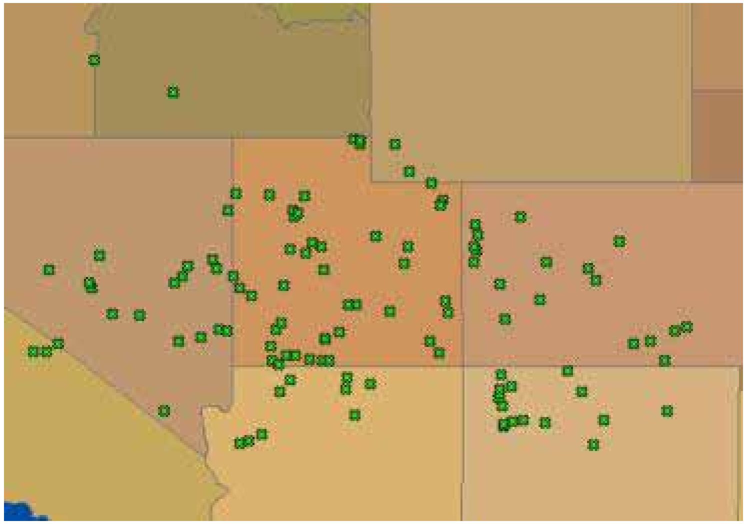

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Environmental Variables:

–Lat/Long

–Elevation

–Temp/Precip

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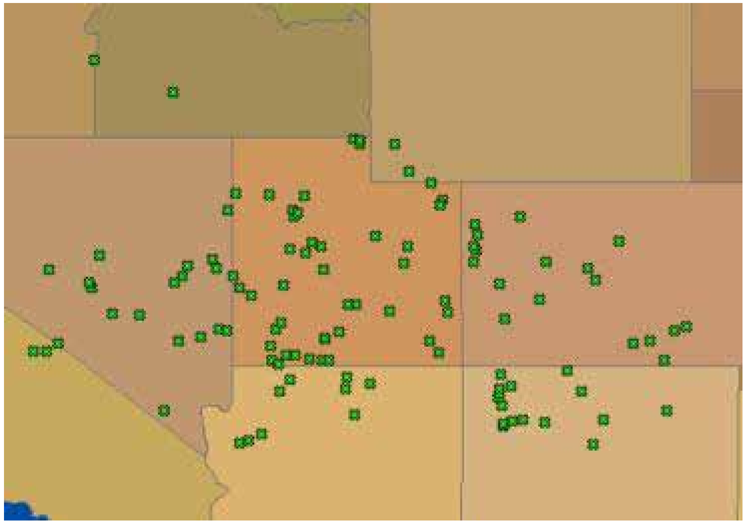

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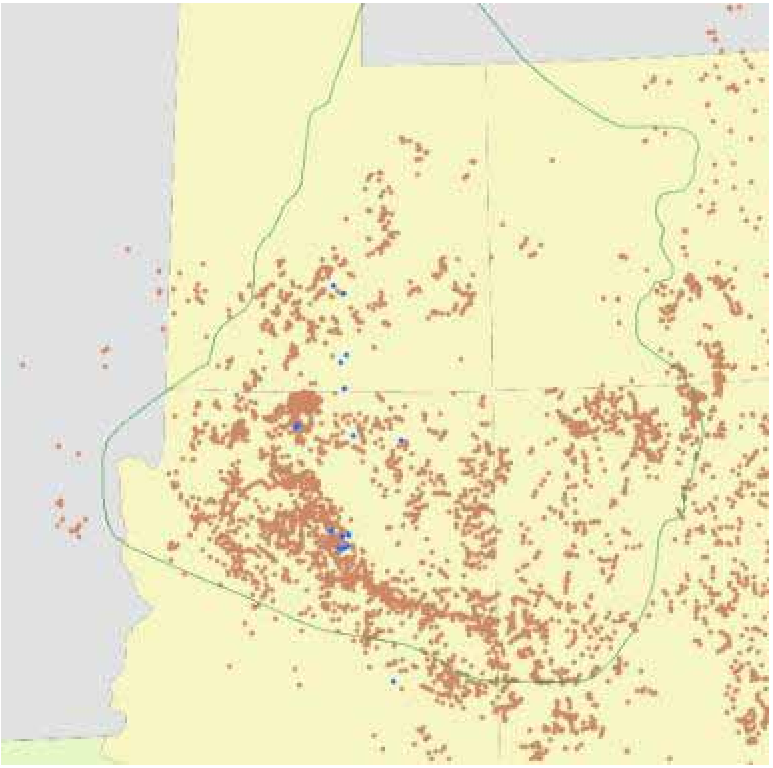
Accessions typed for circa 75 AFLP markers

Bouteloua gracilis



--Breeding system?

--Climax but establishes in disturbed sites

--Ecologically diverse, e.g., soils, elevation

--Southern CP species

--Resilient to grazing

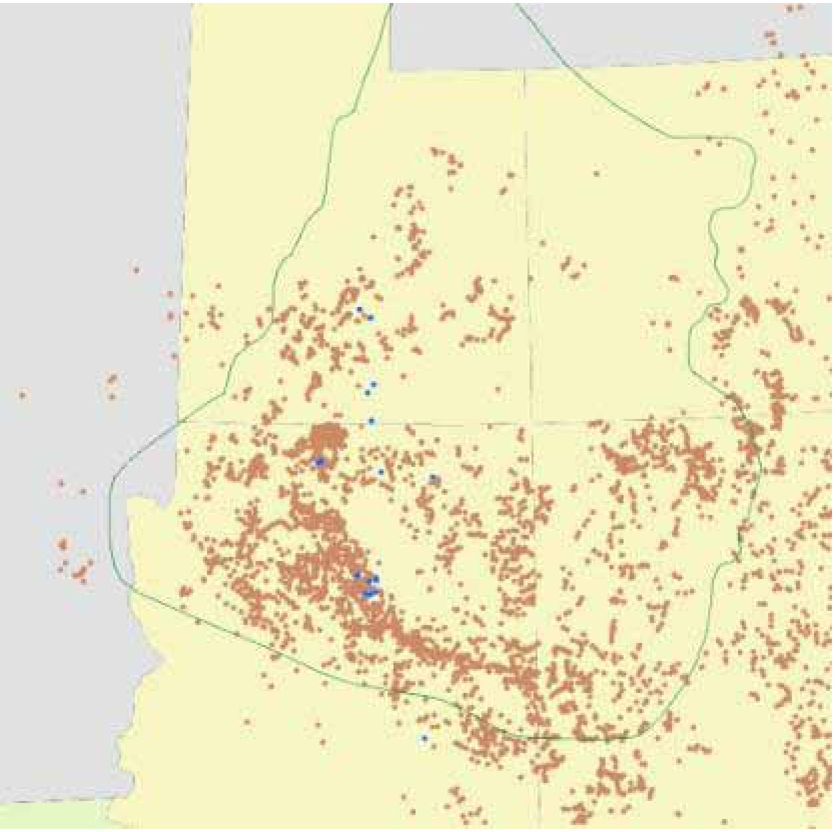
--Cultivars available

--Variation in ploidy level

--Warm season

Distribution data – Kirsten Ironside/Michael Peters, NAU

Landscape Genetics of *Bouteloua gracilis*



(Ironside and Peters)

--sampling (initiated):

--climate layers to identify convergent habitats

--power analysis using simulation models

--seeking collaborator to cytotype accessions

--analysis of marker X environment covariance

--identification of markers that can be tracked thru increase

Distribution data – Kirsten Ironside/Michael Peters, NAU

Summary

- Tension betw. local adaptation & agronomic increase
- Maintaining diversity of restoration species under increase is an important goal
- Characterizing adaptive variation is the fundamental first step
- Possible to track/maintain adaptive genetic variation thru development and increase process (?)